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(56) Documents Cited
GB 2300699 A EP 0241097 A
WPI abstract AN 1985-060368 [10] & RO000085045 (ALIMENTAR) WPI abstract AN 1995-319397 [41] & SU001827772 (SIBE)

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(54) Abstract Title
Animal milk replacer

(57) An animal milk replacer composition comprises cultured skimmed milk in powder form, a fat portion and a protein portion. Preferably, the cultured skimmed milk in powder form is yoghurt powder and is heat treated and derived from skimmed milk concentrate cultured with lactic acid bacteria, such as Lactobillus acidophilus, Streptococcus salivarius, sub-species thermophilus and mixed strain Streptococcus and Lactococcus cultures. The fat portion may be selected from animal or vegetable fats and is preferably tallow, lard, coconut oil, palm kernel oil, palm oil or hydrogenated derivatives thereof. The protein portion is preferably selected from skimmed milk powder, whey powder, delactosed whey powder, whey protein concentrate or vegetable proteins such as soya or wheat protein. Preferably, the composition comprises 0.5-10% by weight of cultured skimmed milk in powder form, 50-70% skimmed milk powder and 12-20% fat. The composition may also comprise a lactic acid adjunct, such as microencapsulated lactic acid powder. The composition is preferably used for calves, lambs, piglets or foals.

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"An animal feed"

This invention relates to an animal feed and more particularly to an animal feed of the milk replacer type for domesticated animals.

Milk replacers are used in animal husbandry to rear young animals such as calves, piglets, lambs, foals and the like which have been separated from their mothers. In order to ensure that the milk replacer mimics a mother's milk as much as possible, milk replacers are generally formulated to as near as possible include all the essential nutrients, vitamins and minerals present in the mother's milk. The milk replacers are frequently fed to the animals in combination with a dry feed.

Frequently, young animals do not find milk replacers to be palatable and as a result can reject the milk replacer. Accordingly, weight gains by such animals can be poor.

Known milk replacers are generally formulated from protein, fat and mineral and vitamin sources such as skimmed milk powder, whey powder, various milk and vegetable protein concentrates, starch, vitamins, minerals and fats.

The milk fat present in original mother's milk for young

animals is usually replaced by other fats of animal or vegetable origin such as tallow, lard, coconut oil, palm oil, rapeseed oil and the like.

Efficacious milk replacers have a number of desirable characteristics including an ability to maximise weight gain in animals, a high level of palatability in animals and an ability to enhance the health of the animal by reducing the incidence of illness and premature death.

A need exists for an improved milk replacer which maximises weight gain and feed intake, and optimises animal health.

An object of the invention is to overcome the problems of the prior art.

A further object of the invention is to provide an improved animal milk replacer.

According to the invention there is provided an animal milk replacer comprising a fat portion, a protein portion and an effective amount of cultured skimmed milk in powder form.

Preferably, the cultured skimmed milk in powder form is derived from cultured skimmed milk concentrate.

Preferably the skimmed milk concentrate is cultured with lactic acid bacteria.

In a preferred aspect of the invention, the lactic acid bacteria is selected from the group comprising *Lactobacillus acidophilus, Streptococcus salivarius subspecies thermophilus* and mixed strain *Streptococcus* and *Lactococcus* cultures.

Suitably, the cultured skimmed milk concentrate is heat treated. Advantageously, the fat is selected from the group comprising animal fats and vegetable fats. Preferably, the animal fat is selected from the group comprising tallow and lard.

In one embodiment of the invention the vegetable fat is selected from the group comprising coconut oil, palm kernel oil, palm oil and hydrogenated derivatives thereof.

In a further embodiment of the invention, the protein is selected from the group comprising skimmed milk powder, whey powder, delactosed whey powder, whey protein concentrate, fat filled derivatives thereof and vegetable proteins. Preferably, the vegetable protein comprises soya or wheat protein.

In a preferred embodiment of the invention the animal milk

replacer comprises 0.5% to 10% by weight cultured skimmed milk in powder form. Preferably, the animal milk replacer comprises 0.75% to 5% by weight cultured skimmed milk in powder form. Most preferably, the animal milk replacer comprises 1% by weight cultured skimmed milk in powder form.

In one embodiment of the invention the animal milk replacer comprises 50% to 70% by weight skimmed milk powder. Suitably, animal milk replacer comprises 12% to 20% by weight fat.

In another embodiment of the invention, the animal milk replacer comprises a lactic acid adjunct. Suitably, the lactic acid adjunct comprises microencapsultated lactic acid powder. Preferably, the animal milk replacer comprises 0.25% microencapsulated lactic acid powder.

In one embodiment of the invention the animal milk replacer is a calf milk replacer. In a further embodiment of the invention the animal milk replacer is a lamb milk replacer.

In a still further embodiment of the invention the animal milk replacer is a piglet milk replacer. In an alternative embodiment of the invention the milk replacer is a foal milk replacer.

The invention also extends to a method for producing an animal milk replacer comprising mixing a fat, a protein and a cultured skimmed milk in powder form. Features of the milk replacer, as given in what follows, are to be read also as features of the method for producing it.

Suitably, the fat is selected from the group comprising animal fats and vegetable fats. In a preferred aspect of the invention (milk replacer and producing method) the protein is selected from the group comprising skimmed milk powder, whey powder, delactosed whey powder, whey protein concentrate, fat filled derivatives thereof, and vegetable proteins. Suitably, the cultured skimmed milk in powder form is derived from cultured skimmed milk concentrate.

Advantageously, the cultured skimmed milk concentrate is cultured with lactic acid bacteria.

Advantageously, the lactic acid bacteria is selected from the group comprising *Lactobacillus acidophilus, Streptococcus salivarius, sub-species thermophilus* and mixed strain *Streptococcus and Lactococcus* cultures.

The invention also extends to use of cultured skimmed milk in powder form in the preparation of an animal milk replacer. The powder is preferably prepared from cultured skimmed milk concentrate.

Suitably, the skimmed milk concentrate is cultured with lactic acid bacteria.

Surprisingly, the applicants have found that when cultured skimmed milk in powder form is included in a milk replacer formulation, and is ingested by animals, the animals enjoy an enhanced weight gain, feed intake and health record as compared with animals fed on a milk replacer without cultured skimmed milk in powder form.

The cultured skimmed milk in powder form is preferably yoghurt powder. More particularly, the cultured skimmed milk in powder form is a heat treated yoghurt powder. Typically, the cultured skimmed milk in powder form is prepared from a cultured skimmed milk concentrate afterward heat treated to from about 69°C to about 71°C. Heat treatment serves to rewarm the concentrate prior to spray drying - the concentrate generally having been cooled after culturing. In the resulting cultured skimmed milk in powder form, only a residual or small proportion of starter lactic acid bacteria typically remains viable.

The cultured skimmed milk in powder form may be formed by culturing skimmed milk concentrate using combinations of commercially available starter cultures. Examples of such cultures include *Lactobacillus acidophilus, Streptococcus salivarius, sub-species thermophilus* and mixed strain

Streptococcus and *Lactococcus* cultures. When a desired level of acidity has been achieved in the skimmed milk concentrate, the concentrate is heat treated as described above and spray dried.

pH values in the range 4.1 to 4.6 and preferably 4.2 to 4.5 are generally preferred for the skimmed milk concentrate.

The amount of cultured skimmed milk in powder form to be employed in the milk replacers of the invention can be varied as required dependent upon the particular application e.g. the species of animal for which the milk replacer is intended, the other ingredients present in the milk replacer and the acidity of the cultured skimmed milk in powder form.

Typically, cultured skimmed milk in powder form will be employed in milk replacers of the invention at levels ranging from approximately 0.5% to approximately 10% by weight of the milk replacer, preferably from approximately 0.75% by weight to approximately 5% by weight of the milk replacer and most preferably at about 1% by weight of the milk replacer.

For example, when the cultured skimmed milk in powder form is incorporated into calf milk replacers at a level of

approximately 1% by weight of the calf milk replacer, an increase in weight gain of approximately 15% as compared with calf milk replacer without cultured skimmed milk in powder form is observed. Moreover, the feed conversion ratio (FCR) i.e. kilograms feed per kilogram weight gain exhibits an improvement of approximately 10%.

Although the applicants do not wish to be bound by any theory, it is believed that the enhanced weight gains and FCR statistics are achieved employing the milk replacers of the invention as a result of a reduction in feed refusal which can, together with other factors, be due to poor palatability. As will be appreciated by those skilled in the art, feed refusal, as well as causing an obvious interruption in nutrition, can also lead to digestive upsets such as diarrhoea or scour. Reduced live weight gain, diminished health status and an increased risk of infections such as bacterial scour and pneumonia can result.

As indicated above, milk replacers in accordance with the invention may be formulated as required to suit the desired characteristics of the end product. A typical milk replacer formulation is made up of: a fat compound such as animal fats such as tallow or lard, or vegetable fats such as coconut oil, palm kernel oil or palm oil or their hydrogenated derivatives; a protein component such

as skimmed milk powder, whey powder, delactosed whey powder, whey protein concentrate and their fat filled derivatives, and vegetable proteins such as soya or wheat proteins; starch; minerals and fats.

The milk replacers, as regards their protein portion, may be skimmed milk powder or non-skimmed milk powder based. Generally, skimmed milk powder based formulations comprise at least 50% by weight of skimmed milk powder while whey powder is also normally included in such formulations.

The milk replacers in accordance with the invention can also include a lactic acid adjunct such as concentrated lactic acid encapsulated in a suitable material for dry blends. The lactic acid adjunct supplements the lactic acid present in the cultured skimmed milk in powder form. The lactic acid adjunct can be used in conjunction with the cultured skimmed milk in powder form. However, with higher levels of cultured skimmed milk in powder form in the formulations of the invention, the levels of lactic acid adjunct may be reduced. However, for example, where cultured skimmed milk in powder form is employed in a calf milk replacer formulation at a level of approximately 1%, it is envisaged that microencapsulated lactic acid powder may be incorporated into the formulation at a level of approximately 0.25%.

Optional ingredients which can also be included in the milk replacers in accordance with the invention are polyclonal antibodies to fight infection and stabilisers such as antioxidants.

Various embodiments of the invention will now be described having regard to the following non-limiting examples:

Milk replacers in accordance with the invention were prepared by dry blending of ingredients in accordance with well established practice. The melted fat was added to evaporator-concentrated skimmed milk, whey, delactosed whey or whey protein concentrate. The emulsion thus formed was then homogenised and spray dried. As will be appreciated by those skilled in the art, the fat component of the fat filled powder may comprise animal fats such as tallow or lard, or vegetable fats such as coconut oil, palm kernel oil or palm oil, or their hydrogenated derivatives. The cultured skimmed milk in powder form, where present, was incorporated before the mixture was homogenised.

Comparative Example:

The following calf milk replacer formulation in accordance with the prior art was formulated:

Ingredient	% by weight
Skimmed milk powder	51.00
Whey powder	27.25
Vegetable fat	18.00
Starch	2.50
Vitamin/mineral premix	1.25
Cultured skimmed milk in powder form	0

Example 1:

The following ingredients were formulated into a calf milk replacer in accordance with the invention:

Ingredient	% by weight
Skimmed milk powder	50.00
Whey powder	27.25
Vegetable fat	18.00
Starch	2.50
Vitamin/mineral premix	1.25
Cultured skimmed milk in powder form	1.00

Example 2: Skimmed milk powder based calf milk replacer

Ingredient	% by weight
32% Vegetable fat-filled skimmed milk powder	54.69
Skimmed milk powder	12.56
Whey powder	27.75
Starch	2.50
Vitamin/mineral premix	1.25

Cultured skimmed milk in powder form	1.00
Microencapsulated lactic acid powder	0.25

The formulation contained 18% fat and 20% protein.

Example 3: Skimmed milk powder based lamb milk replacer

Ingredient	% by weight
32% Vegetable fat filled skimmed milk powder	79.00
Whey powder	15.65
Starch	2.00
Vitamin/mineral premix	1.25
Cultured skimmed milk in powder form	2.00
Microencapsulated lactic acid powder	0.10

The formulation contained 20% protein and 26% fat.

Example 4: Non-Skimmed milk powder based calf milk replacer

Ingredient	% by weight
30% Vegetable fat filled whey powder	53.33
Delactosed whey powder	25.00
Whey powder	4.17
Vegetable protein powder	15.00
Vitamin/mineral premix	1.25
Cultured skimmed milk in powder form	1.00
Microencapsulated lactic acid powder	0.25

The formulation contained 21% protein and 16% fat.

Example 5: Skimmed milk powder based piglet milk replacer

Ingredient	% by weight
Skimmed milk powder	66.00
Vegetable fat	16.00
Dextrose	11.50
Cultured skimmed milk in powder form	3.00
Starch	2.50
Vitamin/mineral premix	1.00

The formulation contained 23% protein and 16% fat.

Example 6: Skimmed milk powder based foal milk replacer

Ingredient	% by weight
Skimmed milk powder	59.00
Vegetable fat	15.50
Dextrose	10.25
Whey powder	10.50
Starch	2.50
Vitamin/mineral premix	1.25
Cultured skimmed milk in powder form	0.75
Microencapsulated lactic acid powder	0.25

The formulation contained 24% protein and 15.50% fat.

The formulation of the Comparative Example and the

formulation of Example 1 in accordance with the invention were fed to calves to examine the palatability of the milk replacer, growth rate and health of the calves, the intake of dry feed, feed conversion efficiency and weight gain.

Trial Procedure:

60 male Holstein Friesian and Holstein Friesian cross calves approximately one week of age were divided into two groups - the first group being fed the formulation in accordance with the comparative example and the second group being fed the formulation in accordance with Example 1. The two groups were subjected to the following feeding regime:

Group 1:

Calves were bucket fed calf milk replacer according to the comparative example twice a day for eight weeks. Dry feed, straw and water were available from day one of the trial.

Group 2:

Calves were bucket fed the calf milk replacer of Example 1 twice a day for eight weeks. As with Group 1, dry feed, straw and water were available from day one.

The dry feed employed for Groups 1 and 2 was made up of the following components:

Ingredient	%
Protein	18
Fat	4.5
Fibre	10
Ash	9

The components of the dry feed were derived from sources such as barley sugar beet pulp, vegetable fat and vegetable protein ingredients such as soya bean meal.

The feeding program was as follows:

Age of Calf	Grams/Powder L/milk/feed
Days 1 to 7	200g made up to 2L/feed
Days 8 to 14	250g made up to 2.5L/feed
Days 15 to 21	300g made up to 3L/feed
Days 21 to 35	375g made up to 3L/feed
Days 35 to 56	150g made up to 1L/feed

Calves were weighed every two weeks and individual milk intake was recorded. Dry feed intakes were recorded initially every four days but as intakes increased the dry feed intake was recorded every two days. Details of all disease incidence and treatments were recorded.

There was no mortality and no animals were removed from the trial. The results of the trial are outlined in

Tables 1 to 3 below:

TABLE 1

Weight Gain

	Group 1 (Comparative Example)	Group 2 Example 1
Initial weight(Kg)	54.3	54.5
Final weight (Kg)	94.1	100.3
Weight gain (Kg)	39.8	45.8
Weight gain %	100	115

TABLE 2

Feed Intake

	Group 1	Group 2
Milk replacer intake (Kg)	24.28	26.75
Dry feed intake (Kg)	66.5	69.3
FCR (Kg feed Kg gain)	2.28	2.09
FCR%	100	92

TABLE 3

Health Records

	Group 1	Group 2
No. of incidences of scour	5 (2 mild, 3 moderate)	1 (1 mild)
No. of incidences of pneumonia	2 (both mild)	2 (1 mild 1 moderate)
Antibiotic treatments	2	1

The scour and pneumonia scores for the calves were graded as follows:

Scour score

1. Mild. Calf alert. Eating recovered in 24 hours.
2. Moderate. Calf slow to eat, had raised temperature but reacted quickly to electrolyte treatment.
3. Severe. Off feed, dull, high temperature. Required heat, electrolytes and possibly veterinary intervention.

Pneumonia score

1. Mild. Raised breathing and temperature, but alert and eating.
2. Moderate. Raised breathing and temperature, slow to eat and dull.
3. Severe. Lying down, not eating, weak, required veterinary intervention.

As shown by the results in Tables 1 to 3 above, the inclusion of cultured skimmed milk powder reduced the number of calves refusing their feed and increased calf milk replacer intake by 9%. The incidence of scour was reduced while dry feed intake also increased to result in a 15% increase in weight gain and an 8.6% improvement in FCR.

The invention is not limited to the embodiments herein described which may be varied in construction and detail.

CLAIMS

1. An animal milk replacer comprising a fat portion, a protein portion and an effective amount of cultured skimmed milk in powder form.

2. An animal milk replacer as claimed in Claim 1 characterised in that the cultured skimmed milk in powder form is derived from cultured skimmed milk concentrate.

3. An animal milk replacer as claimed in Claim 2 characterised in that skimmed milk concentrate is cultured with lactic acid bacteria.

4. An animal milk replacer as claimed in Claim 3 characterised in that the lactic acid bacteria is selected from the group comprising *Lactobacillus acidophilus, Streptococcus salivarius, sub-species thermophilus* and mixed strain *Streptococcus* and *Lactococcus* cultures.

5. An animal milk replacer as claimed in any of Claims 2 to 4 characterised in that the cultured skimmed milk concentrate is heat treated.

6. An animal milk replacer as claimed in any of Claims 1 to 5 characterised in that the fat portion is

selected from the group comprising animal fats and vegetable fats.

7. An animal milk replacer as claimed in Claim 6 characterised in that the animal fat is selected from the group comprising tallow and lard.

8. An animal milk replacer as claimed in Claim 6 characterised in that the vegetable fat is selected from the group comprising coconut oil, palm kernel oil, palm oil and hydrogenerated derivatives thereof.

9. An animal milk replacer as claimed in any of Claims 1 to 8 characterised in that the protein portion is selected from the group comprising skimmed milk powder, whey powder, delactosed whey powder, whey protein concentrate, fat filled derivatives thereof and vegetable proteins.

10. An animal milk replacer as claimed in Claim 9 characterised in that the vegetable protein comprises soya or wheat protein.

11. An animal milk replacer as claimed in any of Claims 1 to 10 comprising 0.5% to 10% by weight cultured skimmed milk in powder form.

12. An animal milk replacer as claimed in any of Claims 1 to 11 comprising 0.75% to 5% by weight cultured skimmed milk in powder form.

13. An animal milk replacer as claimed in any of Claims 1 to 12 comprising 1% by weight cultured skimmed milk in powder form.

14. An animal milk replacer as claimed in any of Claims 1 to 13 comprising 50% to 70% by weight skimmed milk powder.

15. An animal milk replacer as claimed in any of Claims 1 to 14 comprising 12% to 20% by weight fat.

16. An animal milk replacer as claimed in any of Claims 1 to 15 comprising a lactic acid adjunct.

17. An animal milk replacer as claimed in Claim 16 characterised in that the lactic acid adjunct comprises microencapsultated lactic acid powder.

18. An animal milk replacer as claimed in Claim 17 comprising 0.25% microencapsulated lactic acid powder.

19. An animal milk replacer as claimed in any of Claims 1 to 18 characterised in that the milk replacer

is a calf milk replacer.

20. An animal milk replacer as claimed in any of Claims 1 to 18 characterised in that the milk replacer is a lamb milk replacer.

21. An animal milk replacer as claimed in any of Claims 1 to 18 characterised in that the milk replacer is a piglet milk replacer.

22. An animal milk replacer as claimed in any of Claims 1 to 18 characterised in that the milk replacer is a foal milk replacer.

23. An animal milk replacer as claimed in any preceding claim characterised in that the cultured skimmed milk in powder form is yoghurt powder.

24. An animal milk replacer as claimed in Class 23 characterised in that the yoghurt powder is a heat-treated yoghurt powder.

25. A method for producing an animal milk replacer comprising mixing a fat, a protein and a cultured skimmed milk in powder form.

26. A method as claimed in Claim 25 characterised in

that the fat is selected from the group comprising animal fats and vegetable fats.

27. A method as claimed in Claim 25 or Claim 26 characterised in that the protein is selected from the group comprising skimmed milk powder, whey powder, delactosed whey powder, whey protein concentrate, fat filled derivatives thereof, and vegetable proteins.

28. A method as claimed in any of Claims 25 to 27 characterised in that the cultured skimmed milk in powder form is derived from cultured skimmed milk concentrate.

29. A method as claimed in Claim 28 characterised in that the cultured skimmed milk concentrate is cultured with lactic acid bacteria.

30. A method as claimed in Claim 29 characterised in that the lactic acid bacteria is selected from the group comprising *Lactobacillus acidophilus, Streptococcus salivarius, sub-species thermophilus* and mixed strain *Streptococcus* and *Lactococcus* cultures.

31. Use of cultured skimmed milk in powder form in the preparation of an animal milk replacer.

32. Use as claimed in Claim 31 characterised in that the cultured skimmed milk in powder form is cultured with lactic acid bacteria.

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Application No: GB 0001701.2 **Examiner:** Dr Paul D Jenkins
Claims searched: 1-32 **Date of search:** 18 May 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): A2B (BMA9, BMD1, BMD2, BMD4, BMD9, BMD14)

Int Cl (Ed.7): A23C; A23K

Other: Online: AGRICOLA, CAS-ONLINE, EPODOC, FROSTI, FSTA, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2300699 A	(CHARLEVILLE) see especially page 1, lines 6-8 and page 2,lines 12-14	1-32
X	EP 0241097 A1	(FRIESLAND) see especially process 3 and example 5	1-32
X	WPI abstract AN 1985-060368 [10] & RO000085045 (ALIMENTAR) - see abstract		1-32
X	WPI abstract AN 1995-319397 [41] & SU001827772 (SIBE) - see abstract		1-32

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.